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Online Social Connectedness and Anxiety Among Older Adults

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Prior work suggests that for older adults, using the Internet may reduce loneliness and thereby improve mental health. However, most studies concentrate on the relationship between Internet use and depression. Anxiety as an outcome of interest remains less understood, particularly for older adults. Using data from an online survey of older adults age 60+, we examine the relationship between varying ways of socializing online and general anxiety. Differing from past work, we employ use measures that focus on experiences with online social interaction in general rather than restricting these to particular platforms. We find that belonging to online communities and participating in meaningful online discussions are associated with greater anxiety. Participation in meaningful online discussions specifically about health and aging also relate to greater anxiety. Our results suggest a relationship between greater amounts of online social interaction and diminished mental health among older adults.

Keywords: online social interactions, anxiety, older adults, meaningful online discussions, mental health

Worldwide, there is a growing prevalence of mental health conditions, with anxiety one of the most common, affecting 265 million people (World Health Organization, 2018). Mental health conditions are especially prevalent among older adults, impacting approximately 20% of those age 60 and older worldwide (World Health Organization, 2017). Social isolation, which is a particular concern for older adults, is strongly associated with mental health (Miyawaki, 2015), although the relationship between social isolation and anxiety is less clear. Some have argued that using digital technologies to engage with others online may improve psychological well-being by reducing social isolation and loneliness (Cotten, Ford, Ford, & Hale,

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2014). This topic has started garnering increasing amounts of scientific attention (for a review, see Hunsaker & Hargittai, 2018), but studies examining the relationship between varying online activities and well-being apply a range of well-being measures and report differing results (Lifshitz, Nimrod, & Bachner, 2018; van Boekel, Peek, & Luijkx, 2017), making it difficult to know what it is about Internet use that may matter for specific aspects of mental health. In addition, most work focuses on the relationship between online activities and depression, leaving anxiety as a correlate of Internet use less understood. This study fills a gap in the literature by focusing on online social interactions and anxiety among older adults.

With prior work suggesting that the mechanism linking Internet use to mental health is the remediation of social isolation and loneliness (Cotten et al., 2014), it is essential to understand the varied ways in which Internet use may support social connection. Although programming aimed at decreasing loneliness and isolation through technology and online social interaction is on the rise (Griffiths, 2017), lack of evidence regarding the relationship between differing forms of online social interaction and various facets of mental health is a clear limitation given that such approaches may not benefit mental health. In this study, we focus on the relationship of meaningful online social interactions and the specific mental health experience of anxiety.

Internet Use Among Older Adults and Social Connectedness

Older adults represent a growing Internet user base (Anderson & Perrin, 2017) and social media use among older adults is also increasing (Smith & Anderson, 2018). However, this growth masks a consistent lag of this age group compared with the general adult population (Anderson & Perrin, 2017). A Pew Research Center report notes that social media use is more prevalent among older adults who are younger and have higher education and higher income (Anderson & Perrin, 2017). Other work has found that among older adults, younger age and being female significantly relate to using social media, but race, education, and income play no role (Yu, Ellison, McCammon, & Langa, 2016). Older adults value the opportunity for social interaction via social media across generations (Nef, Ganea, Müri, & Mosimann, 2013). The question that follows, then, is whether such Internet use is related to better social connection and mental health.

Since the earliest days of studying the Internet's social implications, scholars have examined the relationship between Internet use and social connections (DiMaggio, Hargittai, Neuman, & Robinson, 2001). Some early work found that the Internet helped in developing strong social ties online (McKenna, Green, & Gleason, 2002), whereas other work pointed to Internet use relating to decreased time with family and friends (Kraut et al., 1998). For older adults, cross-sectional work has reported associations between being an Internet user and greater social support, decreased loneliness, and better psychological well-being (Heo, Chun, Lee, Lee, & Kim, 2015; Seifert, Doh, & Wahl, 2017). Older adults who use online social network sites report higher perceived support from friends and greater social connectedness (Yu, McCammon, Ellison, & Langa, 2016). However, one study also found that older adults report being less socially fulfilled by using Facebook than younger adults (Hayes, van Stolk-Cooke, & Muench, 2015), echoing qualitative work that found that some older adults perceive interactions on social media to be superficial and lacking a depth of thought (Hope, Schwaba, & Piper, 2014; Lehtinen, Näsänen, & Sarvas, 2009; Lindley, Harper, & Sellen, 2009). The ways more mature adults use the Internet for social interaction may therefore matter when it comes to benefiting social well-being.

One set of studies characterizes the online social interactions of older adults, specifically common topics of online discussion, in more detail (Nimrod, 2010, 2011, 2012, 2013, 2014). A content analysis of older adults' interactions in online communities revealed 13 main subjects discussed, including "fun on line," "retirement," "family," "health," "work and study," "recreation," "finance," "religion and spirituality," "technology," "aging," "civic and social," "shopping," and "travels" (Nimrod, 2010). Other related work examined older adults' online discussions of travel (Nimrod, 2012) and fun and leisure (Nimrod, 2011, 2014). The most popular posts were amusement-oriented, or topically related to retirement, family, or health (Nimrod, 2014). Participants identified the opportunity to offer help to others and a gained sense of companionship as benefits of participation in these online communities (Nimrod, 2014). Beyond engaging in these specific discussion topics, older adults who participate in aging-focused communities online exhibited varying approaches to interacting in such groups, including seeking and sharing information or purely social motivations for engagement (Nimrod, 2013). Although prior work has begun to establish a more nuanced understanding of older adults' online social behaviors, the ways in which specific online social interactions relate to mental health are less well understood.

Online Interaction, Mental Health, and Aging

A growing body of work has examined the relationship between Internet use for social reasons and mental health among older adults. Many studies have characterized technology, particularly online social interactions, as positively affecting older adult mental health (Chopik, 2016; Jun & Kim, 2016), although some have raised concerns about the potential for technology-related isolation (Rowe & Kahn, 2015). Given that reports of the prevalence of anxiety disorders among older adults range from 17% to 21% (Byers, Yaffe, Covinsky, Friedman, & Bruce, 2010; El-Gabalawy, Mackenzie, Pietrzak, & Sareen, 2014), anxiety warrants particular attention.

Findings regarding the relationship between generalized anxiety and online social interaction measures across age groups vary (Feinstein, Bhatia, Hershenberg, & Davila, 2012; Grieve, Indian, Witteveen, Tolan, & Marrington, 2013; Shaw, Timpano, Tran, & Joormann, 2015). Results include no association between social networking across varied social network platforms and anxiety (Feinstein et al., 2012), a negative association between social connectedness on Facebook and anxiety (Grieve et al., 2013), and a positive association between interactive communication via Facebook and anxiety (Shaw et al., 2015). A systematic review of the relationships between social network site use and varied measures of anxiety (e.g., generalized anxiety, social anxiety, platform-specific anxiety) reported differing patterns of associations that seemed dependent on how such use was measured (Seabrook, Kern, & Rickard, 2016). For example, social anxiety related to high passive use of Facebook but not to creating Facebook content (Seabrook et al., 2016).

Often, when examining anxiety in relation to digital media use among older adults, anxiety is conceptualized in the context of technology use rather than as the clinical mental health condition (Czaja et al., 2013). Work has also distinguished between computer anxiety, or technophobia, and anxiety resulting from technology use, termed *technostress* (Brooks, 2015). Previous studies have reported associations between technostress and mental health disorders across age groups (La Torre, Esposito, Sciarra, & Chiappetta, 2019), linked technostress to social media use (Maier, Laumer, Eckhardt, & Weitzel,

2012), and reported the appearance of such stress among older adults (Nimrod, 2018). Overall, these findings again reveal the need for further work examining the increasingly varied ways people use the Internet for social reasons and how that relates to mental health for older adults. Given that this past work used specified measures of anxiety, including social anxiety, technical anxiety, and technostress, here we examine generalized anxiety, or clinical anxiety, in relation to online social interaction. We employ a measure of clinical anxiety for two reasons: previous studies have reported differing relationships between online social connectedness and generalized clinical anxiety, and overall this relationship is not well studied for older adults.

We further specify online social interaction to include (1) belonging to online communities and (2) participation in meaningful online discussion, both across a range of topic areas. Given work by Nimrod (2010, 2013, 2014) finding variation in the kinds of topics discussed online (e.g., health, retirement, entertainment) in which older adults participate, as well as in the social benefits they derive from such participation, we examine whether different topics of online community belonging and meaningful online discussion in turn relate to mental health. Based on past work that points to mixed findings between Internet use, specifically Internet use for social reasons, and mental health, we proposed the following research question:

RQ: What is the relationship between meaningful online social interaction in the forms of (a) belonging to online communities and (b) participating in meaningful online discussions, and anxiety among older adults?

Method

Data Collection

We surveyed 1,026 older adults in the United States age 60 and over in summer 2018. We applied this age cutoff by following the definition of old age given by the World Health Organization (2015). We contracted with the online research firm Cint to administer our study to a diverse group of older adults (examples of others using Cint's panel for scholarly research include De Choudhury, Morris, & White, 2014; Hargittai, Piper, & Morris, 2018). Data collection occurred between July 10 and 22, 2018. To achieve a diverse sample, we set quotas for age, gender, race/ethnicity, and education based on U.S. Census figures. Age quotas ensured that our sample did not simply include younger-aged older adults so that we could compare people of different ages across this population. We included the other quotas to make sure we had a diverse sample given findings in digital inequality scholarship about variations in Internet use by sociodemographic factors (Hargittai & Hsieh, 2013). Respondents were sent an invitation to participate in the survey and received compensation for it. They were allowed to skip any questions they did not want to answer.

Measures: Demographic Characteristics

We collected age data by asking about year of birth; the mean age was 69.3 years (*SD* = 6.2). We asked gender and gave the options (a) male; (b) female; and (c) other, please specify. Over half the sample (57%) responded female (the base in our models); no one chose "other." To measure race/ethnicity, we first asked whether the respondent was of Hispanic or Latino origin. Next, participants indicated their race using the U.S. Census categories (a) White; (b) Black or African American; (c) Asian; (d) American Indian or Alaska Native; (e) Native Hawaiian or Pacific Islander; and/or (f) Other, please specify. Our final sample was 82% White (the base in the models), 9% Black, 6% Hispanic, and 3% Asian. Respondents provided their highest level of school completed or highest degree received using the categories (a) less than a high school degree; (b) high school graduate (high school diploma or equivalent including GED); (c) some college but no degree; (d) associate's degree; (e) bachelor's degree; and (f) advanced degree (e.g., master's, doctorate). We recoded these into three categories: 23% completed high school or less (the base in the models), 40% completed some college, and 37% completed college or more. We asked about household income through 12 categories, which we then recoded into a continuous variable using midpoint values (*M* = $60,042, *SD* = $45,161). To determine household size, we asked for the total number of people currently living in the respondent's household, including themselves; 33% of the sample lived alone, 52% lived with one other person, 9% lived with two people, and 6% lived with three or more people (*M* = 1.9, *SD* = 1.0). In regression analyses, we logged the value of household size to address the diminishing returns of having more individuals in a household. Table 1 summarizes the characteristics of our sample.

Measures: Social Context

As previous work has found that among older adults both social capital and loneliness may relate to both online social activity and mental health (Cotten et al., 2014; Sum, Mathews, Hughes, & Campbell, 2008; Yu, McCammon, et al., 2016), we controlled for these variables. We measured respondents' social context using two constructs: social capital and loneliness. We used two measures of social capital adapted from a social support scale initially developed by Cohen and Hoberman (1983) to assess social bonding and social bridging (Williams, 2006). Social bonding, or support garnered from existing strong social ties with family and friends (Putnam, 2000), was measured with five items on a 5-point agreement scale (e.g., "There are several people I trust to help solve my problems"). We averaged responses, which ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). Social bridging signifies the creation of connections across social networks and among individuals of varying backgrounds (Putnam, 2000), which we measured separately in the offline and online contexts. Four items measured using a 5-point agreement scale (e.g., "Interacting with people offline makes me feel like part of a larger community") comprised the offline social bridging scale. We averaged responses so that scores ranged from 1 to 5. Social bonding averaged 3.7 (*SD* = 1.1) and offline social bridging was slightly lower (*M* = 3.3, *SD* = 1.1). (We report on the online social bridging scale below where we describe the online social interaction measures.)

Table 1. Sample Characteristics.

Variable	%	*M*	*SD*	*n*
		Sociodemographics		
Age (years)		69.3	6.2	1,026
Female	57.3			1,024
Race and ethnicity				1,026
White	81.4			
African American	8.7			
Hispanic	6.0			
Asian	2.7			
Native American	1.1			
Education				1,023
High school or less	23.3			
Some college	39.8			
Bachelor's degree or more	36.6			
Income ($)		60,042	45,161	1,018
Household size		1.9	1.0	1,022
		Social Context		
Social bonding		3.7	1.1	1,026
Offline social bridging		3.3	1.1	1,026
Loneliness		4.6	1.8	1,021
		Internet Experiences and Skills		
Using the Internet five or more years	96.6			1,023
Autonomy of use		2.8	1.9	1,026
Frequency of use		19.8	12.9	1,022
Internet skills		2.9	1.1	1,023
		Online Social Interactions		
Online social bridging		2.8	1.2	1,026
Belonging to online communities				
Belongs to one or more	47.3			1,021
Total number of online communities		1.4	2.1	1,021
Meaningful online discussion				
Any participation in 1+ online discussion topics(s)	58.1			1,019
More frequent participation in 1+ online discussion topic(s)	37.2			1,019
		Health		
Health status very good/excellent	40.6			1,026
Memory very good/excellent	63.6			1,025
		Mental Health		
Anxiety		1.5	0.5	1,025
Elevated anxiety	8.9			1,018

We measured loneliness using the Three-Item Loneliness Scale (Hughes, Waite, Hawkley, & Cacioppo, 2004). Questions explore the frequency of feeling a lack of companionship, being left out, and being isolated from others. We used the following response options: 1 = *hardly ever or never*, 2 = *some of the time*, 3 = *often*. We summed responses, so that higher scores indicated greater loneliness, and scores ranged from 3 to 9. The mean score was 4.6 (*SD* = 1.8). We lost five respondents because of missing data for one or more items.

Measures: Internet Experiences and Skills

We measured Internet experiences in four ways: (a) years of Internet use; (b) autonomy of use, (c) frequency of use; and (d) Internet skills. We first asked respondents how long they had been online: "When did you first start using the Internet?" Response options were (a) within the past year; (b) one to two years ago; (c) more than two, but less than five years ago; and (d) five or more years ago. The vast majority of the sample (96.6%, *n* = 991) had used the Internet for five or more years. Given the lack of variation in this measure, we exclude it from the models.

To measure autonomy of use, we asked respondents, "At which of these locations do you have access to the Internet, that is, if you wanted to you could use the Internet at which of these locations?" and guided them to check all that applied from the following options: (a) your home; (b) library or computer lab; (c) school or campus; (d) your workplace; (e) friend's home; (f) family member's home; (g) coffee house/Internet café; (h) community center; or (i) on the go. We derived a count of zero to nine possible access locations; respondents averaged 2.8 (*SD* = 1.9) different points of access. As with number of hours online, we logged number of access points for regression analyses to address the diminishing returns of having greater numbers of Internet access points.

Next, we queried weekly time spent online: "On an average weekday, how many hours do you spend visiting Web sites including social media (but not counting e-mail)?" Response options included (a) none; (b) more than zero, but less than one hour per day; (c) one hour; (d) two hours; (e) three hours; (f) four hours; (g) five hours; and (h) six hours and more. We asked the same question about the average weekend. We recoded responses by multiplying the weekday response by 5 and the weekend response by 2, then summing these for a possible range of zero to 42 hours. The sample reported using the Internet an average of 20 hours per week (*SD* = 12.9). We logged this final number of hours in the regression analyses to account for diminishing returns of additional time online.

To gauge Internet skills, we asked participants to complete a series of questions regarding their understanding of eight Internet-related terms (Hargittai & Hsieh, 2012). We prompted respondents to use a scale ranging from 1 to 5, where 1 = *no understanding*, 2 = *little*, 3 = *some*, 4 = *good*, and 5 = *full understanding*. We averaged these scores, with higher scores indicating greater skills. The mean for the sample was 2.9 (*SD* = 1.1).

Measures: Online Social Interactions

We measured online social interactions in three ways. First, we measured online social bridging by again applying questions derived from the social support scale created by Cohen and Hoberman (1983).

Respondents rated their degree of agreement for each of four statements; response options ranged from 1 (*strongly disagree*) to 5 (*strongly agree*) (Williams, 2006). Questions mirrored those measuring offline social bridging but instead related to online interactions (e.g., "Interacting with people online gives me new people to talk to"). By averaging item responses, scoring ranged from 1 to 5. The mean for the sample was 2.8 (*SD* = 1.2).

Second, we asked about belonging to online communities for 17 different topic areas by asking the question, "Do you belong to any online communities that are specifically devoted to the following topics?" Respondents could check any applicable. Topics included aging-related issues (retirement, caregiving), health-related activities (a health condition you have, a health condition of a loved one, general health and exercise), and several topics focused on general areas of interest (arts and crafts, travel, politics, activism, religion, finances, entertainment, sports, food/recipes, technology, gardening, and an open-ended topic). We derived these 17 topics based on a review of the literature that indicates that these topics are common and potentially meaningful to older adults who participate in online discussions. We included a diverse set of topics, some specific to older adults and others related to general interests. We created two variables from this question by summing the number of online communities in which each respondent participated (*M* = 1.4, *SD* = 2.0) and creating a dichotomous variable indicating whether the respondent belonged to any online communities (47% did).

We then asked respondents about their participation in meaningful online discussions with the question "Taking all of your online interactions into consideration such as time you spend on social media, how often, if ever, have you participated in meaningful online discussions devoted to the following topics?" For each of the same 17 topics listed above assessing belonging to online communities, we used the following response categories: 0 = *never*, 1 = *have done it once or twice*, and 2 = *have done it more often*. For our analyses, we derived two variables to signify participation in meaningful online discussions. The first variable indicated participation in meaningful online discussions of any topic ever if the respondent chose "have done it once or twice" or "have done it more often" for any topic. Over half the sample (58%) reported having engaged in any meaningful online discussion for at least one topic. The fact that more people reported having done this than were part of online communities (47%) shows that meaningful discussions can happen in various online contexts (e.g., in the comments section of news articles) and are not necessarily restricted to specific types of online communities.

The second variable about participating in meaningful online discussions indicated more frequent participation in one or more such conversations when participants chose "have done it more often" for any topic area. More than one third (37%) indicated such participation for at least one topic area. Here, we also generated variables indicating any meaningful online discussion and more frequent meaningful online discussion by topic. The most common topics of at least one-time participation in meaningful discussion were food (33%), politics (31%), and travel (30%). These same topic areas were the most common for more frequent meaningful discussions as well (14%, 16%, and 11%, respectively).

Measures: Health

General Health

Health and memory status also significantly relate to anxiety (Lenze et al., 2001) and so we controlled for these variables. We asked about general health status by applying a widely used, single-item question derived from the SF-36 Health Survey (Ware & Gandek, 1998). The question asks, "In general, how is your health?" and response options are 5 = *excellent*, 4 = *very good*, 3 = *good*, 2 = *fair*, and 1 = *poor*. Just 9% of the sample reported excellent health, 31% reported very good health, 39% good health, 18% fair health, and 3% reported their health was poor. For the regression analyses, we dichotomized this variable to compare those with excellent or very good health with those reporting a lower health state.

Memory

Participants responded to the question "How would you rate your memory at the present time?" using the options 5 = *excellent*, 4 = *very good*, 3 = *good*, 2 = *fair*, and 1 = *poor*. We derived this question from the Health and Retirement Study protocol, a panel study of older U.S. retirees (Ofstedal, Fisher, & Herzog, 2005). One fifth (20%) of respondents reported excellent memory, 43% reported very good memory, 29% good memory, 7% fair memory, and 1% poor memory. As with health, we dichotomized memory status to compare excellent or very good memory with good, fair, or poor memory.

Anxiety

We measured anxiety symptoms using another widely used measure, the Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988; Smith, Ryan, Fisher, Sonnega, & Weir, 2017). Also used in the Health and Retirement Study protocol, the scale measures frequency of occurrence of five different anxiety symptoms over the past week (e.g., "I had fear of the worst happening"). Response items included 1 = *never*, 2 = *hardly ever*, 3 = *some of the time*, and 4 = *most of the time*. We averaged the responses over the five items so that possible scores ranged from 1 to 4, and higher scores indicated more anxiety symptoms. For cases with at least three nonmissing values, we imputed means for missing values (Smith et al., 2017). The mean anxiety score was 1.5 (*SD* = 0.5) and scores ranged from 1.0 to 3.8. To determine the percentage of respondents with clinically significant or elevated anxiety, we summed responses to get total scores ranging from 5 to 20 and then applied a cutoff point for scores ≥ 12 (Gould, Rideaux, Spira, & Beaudreau, 2014). We found that 8.9% of our sample had clinically significant anxiety symptoms.

Analyses

We start by showing bivariate analyses between the Internet use variables and anxiety as our outcome variable of interest. We show results of *t* tests to compare Internet experiences (autonomy of use, frequency of use, and skills) and online social interactions (online social bridging, any belonging to online communities, total number of online communities, any participation in meaningful online discussion, and frequent participation in online discussion) with anxiety scores. We then report the results of linear regression analyses to model the relationship between Internet use and online social interactions with

anxiety. We ran separate regression models to examine the relationship of our variables measuring online social interactions independently. Each model included sociodemographics (age, gender, race/ethnicity, education, income, household size), social context (social bonding, offline social bridging, loneliness), Internet experiences and skills (autonomy of use, frequency of use, Internet skills), and health (general health, memory). We look at online social bridging, belonging to one or more online communities, total number of online communities, any participation in meaningful online discussion in separate models, and more frequent participation in meaningful online discussion. We then ran separate regression models to examine the relationship of our topic-related variables for belonging to one or more online communities and any participation in meaningful online discussion in relation to anxiety. Running separate regression analyses by topic allowed us to move beyond looking at whether any such engagement matters to whether specific topics of discussion are significant. As before, each of these models first included sociodemographics, social context, Internet experiences and skills, and health. Each topic was then added in a separate model following the above variables.

Results

Bivariate Analysis

Table 2 presents bivariate relationships between online social interactions and anxiety. Survey respondents who belonged to at least one online community had significantly higher anxiety scores (M = 1.54, SD = 0.50) than older adults who did not (M = 1.47, SD = 0.54, $p < .05$). Those in the lowest quartile of number of online communities reported significantly lower anxiety (M = 1.47, SD = 0.54, $p < .05$) than older adults in the higher quartiles of online community belonging (M = 1.54, SD = 0.50, $p < .05$). Note that all respondents who did not participate in any online communities additionally comprise the lowest quartile of number of online communities, which explains why the means, standard deviations, and t statistics are the same as the findings for belonging to at least one online community.

Table 2. Bivariate Relationship Between Online Social Interactions and Anxiety.

Variable	Anxiety (M)
Online social bridging LQ	1.47
Online social bridging HQ	1.53
Belonging to 1+ online communities	
Yes	1.54*
No	1.47*
Number of online communities LQ	1.47*
Number of online communities HQ	1.56
Any online discussion	
Yes	1.54*
No	1.46*
More frequent online discussion	
Yes	1.55*
No	1.48*

LQ = lowest quartile, HQ = highest quartile; *$p < .05$.

Older adults who participated in any meaningful online discussion (M = 1.54, SD = 0.53) had higher anxiety scores than those reporting no such participation (M = 1.46, SD = 0.51, $p < .05$). A similar relationship was true for those with more frequent participation in meaningful online discussions. These individuals had higher anxiety scores (M = 1.55, SD = 0.54) than those reporting no participation or infrequent participation (M = 1.48, SD = 0.51, $p < .05$).

Modeling Anxiety Symptoms

We used linear regression to model factors related to anxiety symptoms. In our first set of modeling, we entered socio-demographics, social context, Internet experiences and skills, and health in each model as independent variables. We then added online social interaction variables (online social bridging, belonging to one or more online communities, total membership in online communities, experiencing meaningful online discussion, and participating in meaningful online discussions more frequently) in separate models (see Table 3). We found all measures of online social interactions to be related to greater anxiety. Online social bridging, belonging to an online community, diversity in belonging to online communities, any participation in meaningful online discussions, and more frequent meaningful participation in online discussions all related to greater anxiety.

Table 3. Regression Modeling of Factors Associated With Anxiety.

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	b	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
				Sociodemographics						
Age	.00	.70	.00	.64	.00	.68	.00	.74	.00	.70
Female	.06	.08	.05	.10	.05	.10	.05	.10	.06	.07
Race and ethnicity, White, non-Hispanic (reference)										
African American	−.03	.63	−.03	.61	−.03	.59	−.03	.61	−.02	.67
Hispanic	.04	.52	.03	.62	.03	.62	.03	.60	.03	.60
Asian or Asian American	−.04	.70	−.03	.76	−.03	.77	−.02	.83	−.02	.82
Education, high school or less (reference)										
Some college	.04	.27	.04	.30	.04	.29	.04	.31	.04	.28
College degree or more	.01	.79	.00	.97	.00	.96	.00	.98	.00	.96
Income	.00	.76	.00	.73	.00	.75	.00	.83	.00	.86
Household size	.07	.07	.07	.07	.06	.08	.06	.08	.06	.08
				Social Context						
Social bonding	−.01	.46	−.01	.56	−.01	.56	−.01	.61	−.01	.63
Offline social bridging	−.03	.14	−.01	.77	−.01	.78	−.01	.71	−.01	.69
Loneliness	**.09**	**.00**	**.09**	**.00**	**.09**	**.00**	**.09**	**.00**	**.09**	**.00**
				General Internet Use						
Autonomy of use	.00	.90	.01	.88	.00	.99	.01	.82	.01	.83
Frequency of use	.01	.42	.02	.27	.02	.28	.02	.30	.02	.35
Internet skills	.00	.83	.00	.99	.00	.94	.00	1.00	.00	.94

				Health						
Health status excellent/very good	**−.13**	**.00**	**−.14**	**.00**	**−.14**	**.00**	**−.14**	**.00**	**−.14**	**.00**
Memory status excellent/very good	**−.18**	**.00**	**−.18**	**.00**	**−.18**	**.00**	**−.18**	**.00**	**−.18**	**.00**
				Online Social Interactions						
Online social bridging	**.05**	**.00**								
Belonging to online communities										
Belongs to one or more			**.07**	**.04**						
Total of online communities					**.05**	**.02**				
Meaningful online discussion										
Any participation in 1+ online discussion topics(s)							**.07**	**.03**		
More frequent participation in 1+ online discussion topic(s)									**.08**	**.02**
Constant	1.05	.00	1.04	.00	1.06	.00	1.05	.00	1.06	.00
n	992		989		989		985		985	
Adjusted R^2	.22	.00	.21	.04	.21	.02	.21	.03	.21	.02
F	16.25	.00	15.68	.00	15.75	.00	15.56	.00	15.66	.00

Bold values indicate statistical significance ($p < .05$).

We next used linear regression to model the topical areas of belonging to online communities with anxiety as the outcome (see Table 4). As before, we entered socio-demographics, social context, Internet experiences and skills, and health in each model. We added each topical area for belonging to online communities in separate models. As presented in Table 4, we found that belonging to an online community devoted either to retirement or religion was significantly associated with anxiety. No other topics emerged as significant in modeling and are not included in the table.

Table 4. Regression Modeling of Anxiety by Topics for Belonging to Online Communities (Models 1–2).

Variable	Model 1		Model 2	
	b	*p*	*b*	*p*
Sociodemographics				
Age	.00	.74	.00	.73
Female	.06	.08	.05	.09
Race/ethnicity, White, non-Hispanic (reference)				
African American	−.03	.60	−.03	.52
Hispanic	.02	.74	.02	.76
Asian/Asian American	−.03	.74	−.02	.81
Education, high school or less (reference)				
Some college	.04	.27	.04	.28
College degree or more	.00	.98	.00	1.00
Income	.00	.77	.00	.87
Household size	.07	.05	.06	.08
Social Context				
Social bonding	−.01	.60	−.01	.55
Offline social bridging	.00	.97	.00	.85
Loneliness	**.09**	**.00**	**.10**	**.00**
Internet Experiences				
Autonomy of use	.01	.73	.01	.86
Frequency of use	.02	.20	.02	.23
Internet skills	.00	.87	.00	.82
Health				
Health status excellent/very good	**−.14**	**.00**	**−.14**	**.00**
Memory status excellent/very good	**−.18**	**.00**	**−.18**	**.00**
Belonging to Online Communities				
Retirement	**.11**	**.04**		
Religion			**.13**	**.01**
Constant	1.04	.00	1.06	.00
n	989		989	
Adjusted R^2	.21	.04	.21	.01
F	15.66	.00	15.82	.00

Bold values indicate statistical significance ($p < .05$).

To examine topic-related online social interactions further, we repeated the above modeling, but substituted participating in any meaningful online discussion for online community belonging.[2] Table 5 presents findings for topics related to aging and health, and Table 6 includes topics related to general areas of interest. We found meaningful discussion in each of the topics on aging and health (retirement, caregiving, a health condition you have, a health condition of a loved one, general health and exercise) related to greater anxiety. Six of the 11 topics for general areas of interest significantly related to more symptoms of anxiety: arts and crafts, religion, finances, food/recipes, technology, and gardening. The topics that were not related were travel, politics, activism, entertainment, and sports. (To preserve space, Table 6 does not show the results of these latter models.)

[2] We ran linear regression models examining more frequent participation in meaningful online discussion by topic. Participation in more frequent online discussion about the health of a loved one or food/recipes significantly related to greater anxiety. No other topics exhibited an association.

Table 5. Regression Modeling of Anxiety With Topics of Any Meaningful Online Discussion Related to Aging or Health Topics (Models 1–5).

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	b	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
Sociodemographics										
Age	.00	.72	.00	.71	.00	.79	.00	.90	.00	.84
Female	**.07**	**.04**	.05	.13	.06	.08	.05	.11	.06	.06
Race and ethnicity, White, non-Hispanic (reference)										
African American	−.04	.50	−.03	.59	−.03	.56	−.03	.57	−.04	.41
Hispanic	.03	.63	.02	.78	.03	.64	.03	.67	.02	.71
Asian or Asian American	−.02	.83	−.02	.82	−.03	.74	−.01	.89	−.04	.67
Education, high school or less (reference)										
Some college	.04	.36	.05	.23	.04	.32	.04	.28	.05	.23
College degree or more	−.01	.85	.00	.96	.00	.98	.00	.97	.00	.97
Income	.00	.88	.00	.82	.00	.97	.00	.84	.00	.99
Household size	.06	.11	.05	.17	.06	.12	.05	.15	.05	.13
Social Context										
Social bonding	−.01	.46	−.01	.51	−.01	.56	−.01	.59	−.01	.50
Offline social bridging	−.01	.61	.00	.82	−.01	.60	−.01	.68	−.01	.61
Loneliness	**.09**	**.00**	**.09**	**.00**	**.09**	**.00**	**.09**	**.00**	**.09**	**.00**
General Internet Use										
Autonomy of use	.00	.92	.01	.67	.00	.99	.01	.88	.00	.92
Frequency of use	.02	.33	.02	.23	.02	.27	.02	.26	.02	.21
Internet skills	.00	.83	.00	.93	.00	.89	.00	.92	.00	.99

					Health					
Health status excellent/very good	**−.13**	**.00**	**−.14**	**.00**	**−.12**	**.00**	**−.14**	**.00**	**−.13**	**.00**
Memory status excellent/very good	**−.18**	**.00**	**−.18**	**.00**	**−.17**	**.00**	**−.17**	**.00**	**−.18**	**.00**
					Any Meaningful Online Discussion					
Retirement	**.18**	**.00**								
Caregiving			**.13**	**.00**						
A health condition you have					**.16**	**.00**				
A health condition of a loved one							**.14**	**.00**		
General health and exercise									**.16**	**.00**
Constant	1.10	.00	1.08	.00	1.09	.00	1.12	.00	1.11	.00
n	983		975		985		981		980	
Adjusted R^2	.22	.00	.21	.01	.22	.00	.22	.00	.22	.00
F	16.59	.00	15.63	.00	16.68	.00	16.23	.00	16.36	.00

Bold values indicate statistical significance ($p < .05$).

Table 6. Regression Modeling of Anxiety With Topics of Any Meaningful Online Discussion Related to General Areas of Interest (Models 6–11).

Variable	Model 6		Model 7		Model 8		Model 9		Model 10		Model 11	
	b	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
Sociodemographics												
Age	.00	.77	.00	.95	.00	.94	.00	.73	.00	.95	.00	.87
Female	.03	.29	.06	.09	**.07**	**.05**	.04	.23	.06	.07	.05	.14
Race and ethnicity, White, non-Hispanic (ref)												
African American	−.04	.52	−.05	.36	−.04	.49	−.03	.52	−.03	.58	−.03	.56
Hispanic	.03	.69	.02	.76	.03	.69	.04	.50	.04	.53	.04	.54
Asian or Asian American	−.03	.74	−.03	.79	−.03	.78	−.02	.86	−.02	.84	−.03	.74
Education, high school or less (ref)												
Some college	.04	.32	.05	.23	.04	.26	.04	.28	.05	.23	.04	.30
College degree or more	.00	.92	−.01	.91	.00	.98	.01	.90	.00	.98	.00	.98
Income	.00	.97	.00	.92	.00	.78	.00	.93	.00	.81	.00	.84
Household size	.06	.09	.05	.13	.06	.09	.05	.13	.06	.09	.06	.12
Social Context												
Social bonding	−.01	.64	−.01	.57	−.01	.64	−.01	.56	−.01	.62	−.01	.64
Offline social bridging	.00	.85	−.01	.74	−.01	.75	−.01	.72	−.01	.74	−.01	.69
Loneliness	**.10**	**.00**	**.09**	**.00**	**.09**	**.00**	**.10**	**.00**	**.09**	**.00**	**.10**	**.00**
General Internet Use												
Autonomy of use	.00	.96	.00	.96	.01	.87	.00	1.00	.00	.91	.01	.79
Frequency of use	.02	.28	.02	.28	.02	.26	.01	.45	.02	.27	.02	.24
Internet skills	.00	.98	.00	.99	.00	.95	.00	.95	.00	.76	.00	.89

Health												
Health status excellent/very good	**−.13**	**.00**	**−.13**	**.00**	**−.14**	**.00**	**−.14**	**.00**	**−.13**	**.00**	**−.14**	**.00**
Memory status excellent/very good	**−.18**	**.00**	**−.18**	**.00**	**−.17**	**.00**	**−.19**	**.00**	**−.17**	**.00**	**−.18**	**.00**
Any Meaningful Online Discussion												
Arts and crafts	**.12**	**.00**										
Religion			**.14**	**.00**								
Finances					**.13**	**.00**						
Food, recipes							**.13**	**.00**				
Technology									**.09**	**.02**		
Gardening											**.10**	**.01**
Constant	1.08	.00	1.12	.00	1.13	.00	1.07	.00	1.12	.00	1.09	.00
n	975		971		970		974		971		972	
Adjusted R^2	.22	.00	.22	.00	.22	.00	.22	.00	.21	.02	.21	.01
F	16.00	.00	15.93	.00	15.75	.00	16.33	.00	15.19	.00	15.59	.00

Bold values indicate statistical significance ($p < .05$).

Discussion

To summarize, we found that varying ways of socializing online related to greater symptoms of anxiety when controlling for socio-demographics, social context, health, and general Internet experiences and skills. Online social bridging, belonging to online communities, and meaningful online discussion were all independently associated with greater anxiety. When specifically examining which particular topics may be related to anxiety, we found that belonging to online communities on the topics of retirement and religion related to greater anxiety while holding all other factors constant. When it came to participation in meaningful online discussions by topic, many topics from general ones (e.g., gardening, religion, and finances) to ones specifically about health and aging (e.g., retirement, caregiving, and having a health condition) related to greater anxiety. Our unstandardized coefficients were small across models. However, given that we measured the natural occurrence of anxiety and anxiety symptoms were relatively low, attaining a significant relationship remains noteworthy.

Our findings suggest that although older adults are engaging in a multitude of ways to interact socially online, such use may not relate to more favorable clinical indicators of mental health (i.e., lower anxiety levels). Prior research that employed a generalized anxiety inventory also found that daily social media use (across multiple platforms) associated with a greater likelihood of scoring for clinical anxiety, although the sample focused on young adults (Vannucci, Flannery, & Ohannessian, 2017). However, these findings seem to be unique. A systematic review of the relationship between social network site use (predominantly Facebook use) and anxiety among varying age groups found that a majority of studies reported non-significant relationships between time spent on social network sites and anxiety, including social anxiety (Seabrook et al., 2016). Of note, however, is that all but one of these studies (Baker & Moore, 2008a, 2008b) measured Facebook use unlike our project, which asked about social interactions agnostic to the specific platform where these take place. In addition, few other studies have broken down how people are spending their time on social network sites (e.g., less engaged browsing or content vs. more engaged participation in various types of discussions), which again makes it hard to compare our findings with much prior work. We conclude that our measurements of online social interaction, in which platform remained unspecified and social engagement was emphasized, may point to a differing relationship between online social interaction and anxiety than what existing work has been able to test. It may also be that our findings are specific to the experiences of older adults, and more work may be needed to further explicate this relationship and determine whether such relationships exist for other age groups (Prizant-Passal, Shechner, & Aderka, 2016).

Seabrook and colleagues (2016) noted differing relationships between interacting online and anxiety, with this difference stemming from type of online social interaction, in that case distinguished by negative versus positive experiences. Lee (2014) found that negative interactions on Facebook were related to greater levels of anxiety and positive interactions were related to less anxiety. Whether using or not using social media, older adults may hold negative beliefs regarding online social interaction (Hope et al., 2014; Lindley et al., 2009; Moult, Burroughs, Kingstone, & Chew-Graham, 2018). We employed neutral measures intending to avoid the implication of a positive or negative interaction that inferred beneficial or harmful ramifications. Nevertheless, our results suggest that greater amounts of online social interaction of any sort,

which may include both positive and negative interactions, relate negatively to certain aspects of mental health among older adults.

Past work has hypothesized that the relationship between greater online social interaction and greater social anxiety may be explained by social compensation when individuals with preexisting social anxiety use the Internet for social interaction as a replacement for other methods of contact that may induce distress (Fernandez, Levinson, & Rodebaugh, 2012). Therefore, our findings may be interpreted as identifying individuals with existing higher levels of anxiety who prefer an online approach to social interaction. Said another way, the older adults in our sample with higher anxiety may be using online social interaction in place of socially distressing in-person interactions. Qualitative work, however, has found that older adults who were already reporting distress did not turn to the Internet for social support and voiced a preference for face-to-face interaction (Moult et al., 2018). Therefore, alternatively, if older adults are beginning with less distress when seeking online social interaction, our findings may point to distress potentially stemming from such online interactions.

Technostress, in which issues related to the complexity of the online platform, amount of content presented, or a comparison with younger adults' uses, may result from online social interactions (Nimrod, 2018). Indeed, greater online social interaction may also lead to greater opportunity for social comparisons and in turn elevated anxiety about aging and self-worth. Previous work supports the notion that social comparison may mediate the relationship between receiving social support from friends and mental health (Chou & Chi, 2001). The potential negative repercussions of online social comparisons are more often tied to passive use of social media (Verduyn, Ybarra, Résibois, Jonides, & Kross, 2017); yet, this relationship may differ for older adults.

Our results also show that the topics around which online social interactions occur matter as engaging in topics on health and aging were linked to greater anxiety. Seeking social interaction regarding such topics may relate to distress as they can be emotionally wrought subjects to discuss. Alternatively, older adults may need to manage distressing issues related to aging or health and in turn seek support through such interactions. Qualitative studies have shown that older adults connect with others online to deal with issues of age discrimination (Lazar, Diaz, Brewer, Kim, & Piper, 2017) and changes due to retirement or spousal caregiving responsibilities (Brewer & Piper, 2016) that can all be high-stress experiences.

Although engagement in financial discussion may evoke thoughts of fiscal strain that can occur in later life, past examinations of this topic have reported a balanced emotional tone to the postings of such content (Nimrod, 2010). Nimrod (2013) further characterizes older adults who engage in online communities around financial topics as "information swappers" who use such communities to augment their offline interests (p. 778). One study examining financial advice-seeking reports that older adults do experience heightened anxiety at the possibility of such discussion, because of the potential for embarrassment or a negative assessment of their financial state (van Dalen, Henkens, & Hershey, 2017). Future work might examine the content of online discussion regarding this topic, including the financial issues of concern and the support conferred.

Past work points to varying relationships between religiosity and mental health (Hayward, Owen, Koenig, Steffens, & Payne, 2012). Our finding that online social interactions around the topic of religion relates to greater anxiety implies that engagement with such a topic may be a way to manage distress. Alternatively, those who are religious may be engaging in more religious discussion in an online social context in which individuals hold varying and competing views (Nimrod, 2014); therefore, such discussion may induce feelings of anxiety. A prior study found that individuals who are more religious reported greater anxiety related to Facebook use as well as social anxiety (Davidson & Farquhar, 2014), supporting this interpretation.

Our findings that online social engagement in hobby-oriented topics (arts and crafts, food/recipes, gardening) relate to greater anxiety differ from work documenting the benefit of leisure activity overall on mental well-being (Mannell & Snelgrove, 2012), including anxiety symptoms (Kaufman, 1988). However, it may be increasingly difficult to yield benefits from such activities in old age because of physical and psychological constrictions (Nimrod & Shrira, 2016). It is therefore possible that older adults are interacting online regarding their leisure interests, but not actually doing the hobby and therefore are missing out on the related mental health benefits. Future work might examine whether engaging in hobby-oriented online conversations also correlates with current engagement in such activities.

Given the cross-sectional nature of this study, it is impossible to determine the direction of causality. More work is needed to further explicate how the mental health and well-being of older adults may be impacted by online social interactions and whether it differs by what people's level of anxiety is in the first place. Although we applied quota sampling to include varying ages, our sample included smaller numbers of the oldest old, making further comparisons by age group difficult. Future work might investigate whether differences exist by age in the relationship between online social interaction and anxiety. Including measures of social comparison and aging anxiety might further shed light on why online social interactions may be related to anxiety.

Conclusion

Adding nuance to the existing literature on Internet use and mental health among older adults, we found a clear relationship between differing ways of socializing online and greater symptoms of anxiety, while controlling for socio-demographics, social context, Internet experiences, Internet skills, and health. Using measures with neutral language and leaving platform unspecified, we offer more holistic measures of online social interaction. Such an approach to the measurement of online social interactions may have a longer shelf life than ones that focus on specific platforms given that those can come and go. Older adults may require support when engaging online in the especially salient topics of health and aging. Overall, our work points to a clear need to consider the ways that varying kinds of online social interactions relate to mental health and the unique relationships that can occur for the growing age group of older adults.

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